APC-9¹

F16D 25/12

PATENT SPECIFICATION

(11) 1 562 709

1 562 709

(21) Application No. 48025/76 (22) Filed 18 Nov. 1976
(23) Complete Specification filed 8 Nov. 1977
(44) Complete Specification published 12 March 1980
(51) INT CL³ F16D 25/12
(52) Index at acceptance
F2L 5M1 5M5 7B
F1D P18A

(72) Inventors HAROLD HODKINSON and MERVYN BRIAN PACKER

DOC

(54) A CLUTCH HYDRAULIC ACTUATION SYSTEM

(71) We, AUTOMOTIVE PRODUCTS LIMITED, a British Company of Tachbrook Road, Leamington Spa, Warwickshire, CV31 3ER do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to clutch hydraulic actuation systems and more particularly to such systems for combinations of an internal combustion engine, and a friction clutch.

In certain hydraulic actuation systems for friction clutches associated with internal combustion engines of motor vehicles, there is a tendency for vibrations to develop in the hydraulic actuation system and for these to be audible to the driver of the vehicle and to be felt by the driver through a conventional clutch pedal.

It is an object of the present invention to provide a simple means for attenuating such vibrations.

According to the present invention there is provided a clutch hydraulic actuation system having a vibration attenuator provided in the hydraulic actuation system between a master cylinder and a slave cylinder thereof, said attenuator including a boundary of the hydraulic system constituted by a stiff diaphragm, as defined herein, that can follow vibrations transmitted through the hydraulic fluid in the system, and has the effect of damping the fibrations.

By a stiff diaphragm is meant a diaphragm made of a rigid material having a high natural frequency so that it can follow the frequency of the relevant vibrations and which has a low loss hysterisis, so that materials such as flexible rubbers or elastomers are not intended to be within the scope of this invention.

Preferably the diaphragm comprises a sheet steel plate supported around its periphery, with one face acted on by hydraulic fluid of the hydraulic actuation system and the other face open to atmosphere.

Two embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:—

Fig. 1 is a diagrammatic representation of a combination of internal combustion engine, friction clutch and hydraulic actuation system for a clutch, in accordance with the invention;

Fig. 2 is a diagrammatic cross-section through one form of vibration attenuator;

Fig. 3 is a view in the direction of arrow III of Fig. 2; and

Fig. 4 is a diagrammatic cross-section through an alternative form of vibration attenuator.

Fig. 1 shows in diagrammatic form a conventional internal combustion engine 11. The engine incorporates a 4-throw crankshaft 12 which runs in three main bearings 13. The rear of the crankshaft 13 carries a flywheel 14 on which is mounted a friction clutch 15 which may for example be a conventional diaphragm spring clutch. Release and engagement of the clutch controls the inter-connection of the engine with a gearbox input shaft 16.

A clutch release bearing 17 is movable axially to release or engage the clutch by means of a clutch release fork 18 which is pivoted at 19 to a clutch bell housing or other structure which is integral with the engine 11.

The clutch release fork is operated hydraulically from a driver controlled clutch pedal 21. The clutch pedal is pivoted at 22 and carries a pushrod 23 which operates the piston 24 of a hydraulic master cylinder 25. The piston is sealed in the cylinder by a seal 20 which has an inherent frictional resistance to movement in the cylinder, the effect of which will be explained subsequently. The master cylinder may be of any conventional construction and may incorporate many detailed features not shown in the drawing

such as a conventional reservoir for hydraulic fluid. One hydraulic connector tube 26 leads from the master cylinder 25 to a vibration attenuator 27, which will be described in detail subsequently, and a second hydraulic connector tube 28 leads from the vibration attenuator to a hydraulic slave cylinder 29. The slave cylinder incorporates a piston 31 which is connected by a pushrod 32 to the release fork 18.

Figs. 2 and 3 show a vibration attenuator such as 27 (Fig. 1) in further detail. The vibration attenuator comprises a machined body 33 which incorporates a circular recess 34 in one face. A spring steel diaphragm 35 is set into the face which incorporates the circular recess 34 and the diaphragm is held in place by a retainer plate 36 having a circular aperture 37 and which is bolted at 38 to the body 33. The diaphragm 35 is sealed around the recess 34 by means of a peripheral seal 39. The body 33 incorporates two threaded connections 41 which communicate with the recess 34. The vibration attenuator of Figs. 2 and 3 is connected into the hydraulic actuation system of Fig. 1 by means of its threaded connections 41 and thus this vibration attenuator becomes the vibration attenuator 27 of Fig. 1. The diaphragm 35 and its mounting is such that the diaphragm can vibrate with very little frictional damping.

In operation of the complete system, when the vehicle engine is rotating and the release bearing 17 is engaged against the clutch by the hydraulic system, there is a tendency for the release bearing to vibrate in an axial direction. It is believed that this vibration may be due to vibration of the engine crankshaft in a bending mode. These vibrations tend to occur at one or a small number of specific engine speeds and the vibration frequency tends to correspond to specific harmonics of engine speed. Typical vibrations frequencies are between 60Hz and 90Hz. In the absence of the vibration attenuator 27, there is a tendency for these vibrations to be transmitted with a substantial amplitude through the hydraulic system to the clutch pedal 21 and to the driver's foot when the clutch is being operated. This vibration can result in undersirable discomfort and noise.

The provision of the vibration attenuator 27, the diaphragm 35 of which (Fig. 2) is designed to be capable of following the pressure vibrations transmitted through the hydraulic fluid tends to attenuate this vibration as felt at the clutch pedal. The diaphragm is capable of following the vibrations transmitted through the fluid by virtue of its very low damping and a natural frequency sufficiently above the frequency of the revelant vibrations to obviate resonance effects. It is desirable for the vibration attenuator 27 to be arranged close to the master cylinder 25, because this increases its effectiveness.

It appears that the vibration source exhibits a high degree of stiffness in that its amplitude is virtually independent of any damping in the hydraulic circuit. The effect of the attenuator appears to be to allow the hydraulic system to expand and contract as the full amplitude vibration is transmitted to it, without building up an excessive pressure variation.

If the residual pressure fluctuations are insufficient to overcome inherent friction losses within the master cylinder, complete isolation of vibrations from the foot pedal is achieved but even with greater residual pressure fluctuations the vibrations at the clutch pedal are attenuated.

The vibration attenuator shown in Fig. 4 comprises a circular machined body 43 which incorporates a circular recess 44 in one face. A spring steel diaphragm 45 is held against the face which incorporates the circular recess 44 by means of a retainer sleeve 46 which has an accurately preformed lip 47 engaged round the edge of the diaphragm 45. The opposite end of the sleeve is rolled over the corresponding edge of the body 43 at 48 to secure the diaphragm in position. The diaphragm 45 is sealed around the recess 44 by means of a seal 49. The body incorporates two threaded connections 51 which communicate with the recess 44 and can be used to connect the attenuator into the clutch actuation system of Fig. 1. Operation of the attenuator of Fig. 4 corresponds to that of the attenuator shown in Figs. 2 and 3.

WHAT WE CLAIM IS:—

1. A clutch hydraulic actuation system having a vibration attenuator provided in the hydraulic actuation system between a master cylinder and a slave cylinder thereof, said attenuator including a boundary wall of the hydraulic system constituted by a stiff diaphragm, as defined herein, that can follow vibrations transmitted through hydraulic fluid in the system and has the effect of damping the vibrations.

2. A clutch hydraulic actuation system as claimed in Claim 1, wherein the attenuator is adjacent the master cylinder in said system.

3. A system as claimed in Claim 1 or Claim 2, wherein the diaphragm comprises a sheet steel plate supported around its periphery and having one face acted upon by the hydraulic fluid and the other face of which is open to atmosphere.

4. A clutch hydraulic actuation system substantially as described herein and with reference to the accompanying drawings.

5. A combination of an internal combustion engine, a friction clutch and a clutch hydraulic actuation system as claimed in any proceeding claim.

For the Applicants
L. H. STREET — Solicitor

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1562709 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

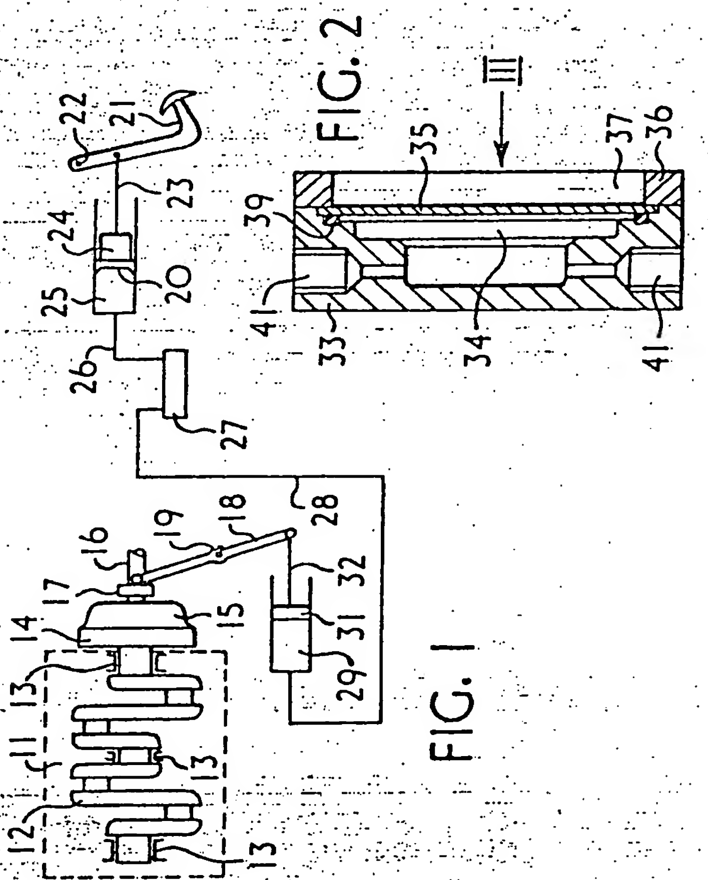

FIG. 2

FIG. 1

1562709 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

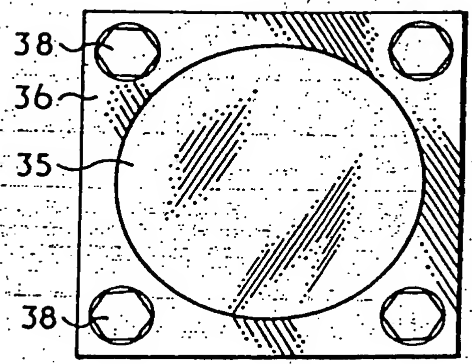

FIG. 3

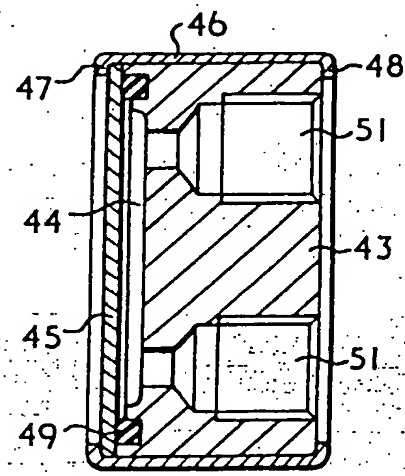

FIG. 4